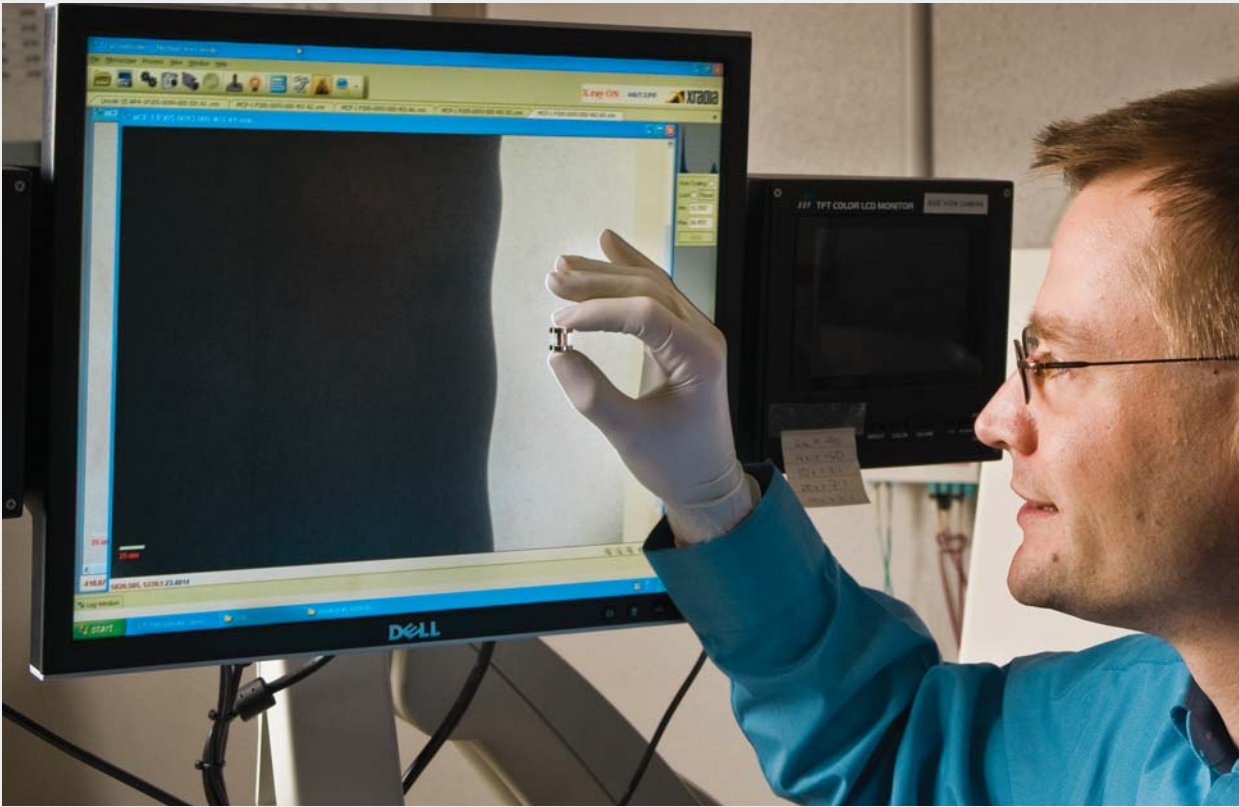


# Sandia images the sea monster of nuclear fusion: the Rayleigh-Taylor instability



BUT IS IT ART? — Dan Sinars examines one of the aluminum cylinders used in the Z pulsed power experiments. The monitor on the X-ray machine in the background displays a highly-magnified, pre-experiment view of the wavering edges machined into the outside edge of the cylinder. These were used to intentionally start the growth of the instability. (Photo by Randy Montoya)

## More accurate simulations could lead to ‘break-even’ fusion in foreseeable future

By Neal Singer

Researchers at Sandia’s Z machine this summer applied a new X-ray imaging capability to take pictures of a critical instability at the heart of the huge accelerator. The pictures may help remove a major impediment in the worldwide, multidecade, multibillion dollar effort to harness nuclear fusion to generate electrical power from seawater.

“These are the first controlled measurements of the growth of magneto-Rayleigh-Taylor [MRT] instabilities in fast Z-pinches,” says project lead Daniel Sinars (1643).

MRT instabilities are spoilers that arise wherever electromagnetic forces are used to contract (pinch) a plasma, which is essentially a cloud of ions. The pinch method is the basis of the operation of Z, a dark-horse contender in the fusion race.

A pinch contracts plasma so suddenly and tightly that hydrogen isotopes available from seawater, placed in a capsule, should fuse.

That’s the intent. Instead, the instability crimps the cylindrically contracting plasma until it resembles a string of sausages or shreds the plasma into more fantastic, equally useless shapes. This damaged contraction loses the perfect symmetry of forces necessary to fuse material.

Fast pinches at Z, which take place in less than 100 nanoseconds, already have produced some neutrons, a

(Continued on page 4)

## New Mexico, California sites honor American veterans



Sandia/New Mexico and Sandia/California sites observed Veterans Day 2010 with formal ceremonies honoring those who have served in America’s armed forces. In what has become a tradition at the New Mexico site, the Veterans Day observance was combined with a celebration of Native American Heritage Month. For more about the celebrations at both sites, see stories and photos on page 8.

## Annual survey tracks evolving attitudes about national security issues

Sandia-supported National Security Public Attitudes Project asks questions about nuclear weapons, terrorism, energy security, and more

By Shannon Guess

Beliefs About the Security Environment			
Which of these statements that contrast views about world security today do you agree with the most?			
(Random Order)	1999	2001	2010
Today the world is a less dangerous place for the US than it was during the Cold War.	36%	24%	23%
Today the world is a more dangerous place for the US than it was during the Cold War.	64%	76%	77%

ALTHOUGH SHARPLY SURGING likely in response to the Sept. 11 attacks, the public continues to evaluate the world as more dangerous for the US despite many measures put in place to mitigate threats.

More than three-quarters of respondents in a recent national survey said they believe today’s world is a more dangerous place for the US than it was during the Cold War. The same survey found that in the past year Americans perceive the effectiveness of security efforts at US airports, seaports, and the nation’s borders is declining. The survey also found that within the next 20 years,

(Continued on page 4)

# Sandia LabNews

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## National Security Speaker Series Arms control in the 21st century



ROSE GOTTEMOELLER, assistant secretary of state for the Bureau of Arms Control, Verification and Compliance, and Sandia President and Labs Director Paul Hommert share a light moment prior to a presentation at Sandia’s CNSAC (Bldg. 810) auditorium. In prepared remarks, Gottemoeller spoke on the subject “Advancing the Arms Control Agenda in the 21st Century.” In her comments, she discussed President Barack Obama administration’s perspective on the importance of the New START Treaty to the nation’s long-term security and why it should be ratified by the US Senate. Gottemoeller served as deputy undersecretary of Energy for defense nuclear nonproliferation and before that as DOE assistant secretary for nonproliferation and national security. Gottemoeller spoke at the Labs as part of the National Security Speaker Series, which brings senior US policy officials and former officials to Sandia to share their thoughts and interact with Sandians on the nation’s key security issues. The goal of the series is to increase Sandians’ understanding of the unique role and contribution of the national laboratories to the national security strategy in the post-Cold War environment. (Photo by Randy Montoya)



### Bioenergy R&D upswing

Work led by Rajiv Bharadwaj and Aarthi Chandrasekaran, performed at the Joint Bio Energy Institute in California, this month appears in three prominent scientific journals, including the cover of *Analytical Chemistry*. Read about the work on page 3.



### Sustainability guru

Geoffrey West, former president of the Santa Fe Institute, will speak at the first meeting of Sandia’s Catalyst Networking Group about universal scaling laws and their implications for sustainability. Read about West’s provocative ideas on page 5.



That’s that

Saw a news release not long ago announcing a new book, *Virtual Travel: Embrace or Expire*, by futurist Barry Shuler. The first sentence of the news release pretty much sums up the premise of the book: “What if you could have an entire travel experience – complete with smells, sights, touch, interactions – without physically traveling?” Shuler makes a compelling argument that within the foreseeable future – the very foreseeable future, in fact – travel to any destination will be accessible and affordable to virtually everyone. The subjective experience will be so realistic, Shuler says, “that it will be indistinguishable from traditional physical travel. . . . All of the downsides to physical travel will be a thing of the past.”

To me, this all sounds like fun, but is it really travel or is it more like a very sophisticated theme park ride? If you travel virtually to Hawaii, have you really been there? If you catch a virtual 40-foot-wave on the North Shore, can you really claim to be a member of the same fraternity as Laird Hamilton? If all the risks, all the “downsides,” (as Shuler calls it) of travel are eliminated, is it really a fully human experience? I don’t have an answer for this; it probably falls into the sphere of metaphysics.

Regardless of these heavy questions, I’m pretty sure that something much like what Shuler describes will come to pass. And that has implications for us not just as individuals but as Sandians. With today’s technology, it’s quite possible to attend a conference or a business meeting via video linkup, but the experience is, in many ways, just not the same as being there. Given today’s level of the possible, Sandians – along with business and professional travelers from around the globe – still prefer to go through all the hassles of the airport and the hotel room (and bedbugs?), put up with the uncertainties of weather and who knows what all, to actually go somewhere. To be there. Not too long from now, Shuler says, you can just stay home. And if everything related to physical location is possible, where, exactly, is home? Wouldn’t everyone “live” in Hawaii? Will there still be a Peoria?

\* \* \*

On second thought, let me hedge just a little bit on the first sentence in the paragraph above: Whenever I read predictions from self-described futurists, I always think about the illustrations on the covers of magazines like *Popular Mechanics* and *Popular Science* from the 1930s. You probably know the ones I mean, the pictures of the city of the 1980s – just 50 years in the future! – with monorails and personal aircraft thick as swallows in the skies above a shining city on a hill. And we know how that turned out. Jocularly aside, if I had to put money down, I’d bet Shuler’s onto something here. And if I were in the travel business, as a hotelier or airline executive, for example, I’d be thinking very hard about my options.

\* \* \*

Last week I was fortunate enough to attend a remarkable event, one that required me to think deeply on a subject about which, I’m sorry to say, I haven’t given nearly enough thought. In a cold airplane hangar at the west end of the airport, no less than 1,000 people gathered for a dinner/dance to support the Wounded Warrior Project, a nonprofit group whose charge is to meet the physical, medical, and emotional needs of men and women who have been wounded in battle. The main speaker that evening was Dan Nevins, who as an Army National Guard staff sergeant lost both legs to an improvised explosive device in Iraq in 2004. Nevins offered a testimonial about how the Wounded Warrior Project has made a difference in his life. It was awe-inspiring and humbling to hear this man, who shed his blood for this country, talk about his injuries and his recovery. He quoted a passage from a speech made a few years back by an Army general at the dedication of the Wounded Warrior headquarters in Jacksonville, Fla. The line that stuck with me was: “I object when I hear people say you *lost* your leg, or you *lost* your arm, or you *lost* your sight. They’re wrong. You *gave* a leg; you *gave* an arm, you *gave* your sight as gifts to your nation that we might live in freedom.”

As Thanksgiving approaches, we think about the many things we’re thankful for: our families, our friends, our jobs, and not least, the blessings bestowed by liberty. This year, too, thanks to Dan Nevins and his deeply moving narrative, I’m grateful for the sacrifices – the selfless gifts – the men and women of our armed forces offer on my behalf.

If you want to know more about Wounded Warriors Project, check out the website at [www.woundedwarriorproject.org](http://www.woundedwarriorproject.org). See you next time.

– Bill Murphy, (505-845-0845, MS0165, [wtmurph@sandia.gov](mailto:wtmurph@sandia.gov))

Employee death

Mike Eckley revealed his artistic flair when it came to sushi

Mike Eckley (2661) died on Nov. 4. He was 56 years old and had been at Sandia 19 years. “Mike worked as a system test engineer for Sandia’s Integrated Correlation and Display System (ICADS) that helps the US Air Force recognize nuclear detonations and other like-phenomena on a worldwide basis. He planned and executed tests to verify the software performed as required before allowing it to be delivered to the Air Force.” says senior manager John Vonderheide (2660). “Mike’s expertise in testing and his knowledge of satellites and communications were vital to this critical national program. Mike was well-liked and respected by everyone.”

“Mike has been our team’s go-to person for history and system knowledge,” says Jerry Karasz (2661). “He worked on this project for more years than anyone else on our team. His legacy knowledge of the software, the domain, and the other project groups was invaluable to us. Mike was level-headed and thoughtful. He always knew what questions to ask to get to the bottom of any issues. Our group often focuses so closely on our tasks; it was Mike who suggested new ideas or opportunities.”



MIKE ECKLEY

Colleague Curt Kuper (2661) says Mike was great to work with. “He was always in a good mood. He had a wonderful sense of humor. I never heard him complain about anything. He was very knowledgeable on our project and we would often ask for his input and advice. I am very happy to have known him and will miss him very much.”

Janice Washington (2661), another colleague, says one of Mike’s hobbies was making sushi. “Some of the rolls he made would make a professional sushi chef jealous,” Janice says. “His attention to detail and artistic flair showed brilliantly when he made sushi.”

Recalls An Chang (2661), “Mike was an early bird; he was in the office by 6:30 a.m. Mike had a slight limp from an earlier horse accident and a history of heart issues, but you could never tell. He told these stories with fun details as if were reporting live, never from a patient’s perspective. He saw those incidents as just some bumps in life.

“He loved Asian food. With his buddies or by himself, they tried out just about every Asian restaurant south of Menaul over the years.”

“Mike was not afraid to stand out, dare I say, to look foolish,” Jerry adds. For our division Halloween party this year, he dressed up in a jellyfish costume, likely the most unique costume, if not the most guessable. Lots of folks had a hard time figuring out what he was supposed to be.

“Mike raised bees on his property in the East Mountains. He would tell me about how to work with bees, and how he would check on them. He would tell me about the plants to keep around for the bees. Unfortunately I did not get to try any of the honey.” — Iris Aboytes



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Employee death

I’m not worried about me, make sure you take care of . . .

Scott Bullock (2542) died on Nov. 4. He was 56 years old and had been at Sandia almost 10 years. “Scott was a cheerful, fun-loving, and caring person,” says his supervisor, Cedric Hawkins (9343). “There were many projects in On-Site Calibration & Maintenance where he shared his knowledge of the equipment in a particular area and had ideas to improve the process.

“Scott loved fast cars and Harleys. I remember when he purchased a new Nissan sports car and traded it the following year for a faster one. He took time to explain to me the difference in the performance as well as the options. He loved his Harley equally. When he traveled to places he had not been, he would seek Harley stores to purchase the local flavor of a T-shirt and memorabilia.”

Friend Bob Hurtado says Mike was “a hard worker who was always willing to come in early and stay late. His hobbies were first and foremost his family, a brand new granddaughter, hunting, fishing, and his Harley. Scott was concerned with little things. I believe if I or any other of his friends had a problem in the middle of the night, he would be there, no problem. He fought till the end and never complained.”

Marie Garcia (2542) recalls that Scott used to call her “an indoor type of girl, adding that “on a particularly challenging day, Scott stopped by my office. He knew I



SCOTT BULLOCK

was having a tough time with my new work assignments. I told Scott I can’t do this job, I don’t know the equipment, I can’t do it. ‘Yes you can,’ he told me. ‘I’ll help you. You can do this, Marie.’ Scott went out of his way and helped me learn to work with the equipment, testers, procedures — everything. He was patient, kind, and did everything he could to make sure I succeeded. Scott was open and eager to share his knowledge and expertise of the equipment. He had an amazing sense of humor and the days working with him were a blast. I looked forward to going to work.”

“Scott was a good listener,” says Dave Fraqua (2542). “It was good to know you could sit down and talk about anything and know he was listening. He always treated us as if we had been friends all our lives.”

Marie remembers the time when she was working in another building a couple of weeks after Scott had left on medical leave due to his cancer. “Customers asked if we were as short-handed as they had heard,” Marie says. “One gentleman said, ‘Well, as long as you don’t lose that one guy who knows everything about all the equipment, you’ll be fine. I think his name is Scott.’ I told him that unfortunately Scott had left. His response was, ‘Oh, then you guys are screwed.’ That was the level of respect customers had for him.”

“Scott didn’t just love his toys, he loved people,” Cedric adds. “As Scott’s supervisor, he always encouraged me to take care of his teammates, rather than himself. He always said to me, ‘I’m not worried about me, make sure you take care of . . .’” — Iris Aboytes



# Small-scale technologies for large-scale biofuels production



**SMALL BUT SPEEDY** — Rajiv Bharadwaj holds up the chip that is the basis of a high-throughput method to evaluate the effectiveness of digestion methods. The method, featured on the cover of *Analytical Chemistry* this month, provides quantitative information about all sugars in a sample, not just the monosaccharides.

**Story by Patti Koning • Photo by Randy Wong**

You could call November “Microfluidics meets Bioenergy Research” month. Work led by Rajiv Bharadwaj and Aarthi Chandrasekaran (both 8621), and performed at the Joint Bio Energy Institute (JBEI), this month appears in three prominent scientific journals, including on the cover of *Analytical Chemistry*. “We’re coming back from a 35-year hiatus on bioenergy research. There was a lot of effort in the 1960s and 1970s, but when gas prices tanked, the lack of funding and political will brought the work to a halt,” says Anup Singh (8621). “With the crises in oil-producing nations and the sudden spike in oil prices a few years ago, research has started up again with a major influx of funds from government and industry.” Anup is the manager of the biosystems and bioengineering group at Sandia and director for high-throughput chemical analysis at JBEI.

Because of that long pause, the tools to conduct basic research are sorely out of date. Advances in other areas of biology often don’t easily translate to bioenergy.

“We need tools that allow researchers to screen processes and molecules in a high-throughput manner and do assays faster and cheaper with smaller amounts,” Anup says. “The microfluidics core at JBEI has been examining the state of the art to see how the lack of technology is slowing down researchers in terms of getting to their biological end goals. We now have some great successes, with a common theme of increasing speed and efficiency, to share with the rest of the bioenergy community.”

Rajiv is the lead author of a paper titled “Microfluidic glycosyl hydrolase screening for biomass-to-biofuel conversion,” the cover story for the Nov. 15 issue of *Analytical Chemistry*. The other authors (all part of JBEI) are Zhiwei Chen (8634), Supratim Datta (8634), Bradley Holmes (8634), Rajat Sapra (8634), Blake Simmons (8630), Paul Adams (Lawrence Berkeley National Laboratory), and Anup.

This paper describes a new method for screening the effectiveness of digestion, the process by which treated biomass is converted into fermentable sugars. To evaluate a particular digestion method, researchers need to know the profile of the various sugars it produces. The characterization of various oligosaccharides produced during biomass digestion is critical for the design of

suitable reactors, enzyme cocktail compositions, and biomass pretreatment schemes.

The state-of-the-art screening technique is high-performance liquid chromatography (HPLC), which takes several hours to complete. Rajiv’s research moved this screening process to a chip, drastically reducing the amount of sample needed and slashing the time from hours to just minutes.

“Our goal was to create something you can keep running all day and process hundreds of samples in the time it used to take to do one. This method is much more sophisticated because it provides quantitative information about everything in the sample, not just the monosaccharides,” he says.

This chip-based screening method also has potential for industrial settings, Rajiv adds. “Industrial production will be greatly scaled up from what we are doing in the lab, so the ability to troubleshoot quickly is essential,” he explains. “You can also use this method to pre-screen each batch of biomass digestion so you don’t waste fermenter time.”

Another project of Rajiv’s, described in the paper, “High-throughput enzymatic hydrolysis of lignocellulosic biomass via in-situ regeneration,” appears in *Biore-source Technology*. The other authors are April Wong (8621), Bernard Knierim (JBEI), Seema Singh (8934), Bradley, Manfred Auer (JBEI), Blake, Paul, and Anup.

This project tackles the logistical problem of accurately metering small amounts of insoluble biomass for enzymatic digestion. The metering of ionic liquid (IL) pretreated biomass is typically performed either by weighing biomass or dispensing a biomass slurry solution. Both of these approaches are cumbersome and prone to variability, especially for high-throughput screening.

Rajiv hit upon a novel solution by observing that when IL-solubilized biomass is placed in a microwell containing water, the biomass precipitates to the bottom. In this volumetric metering method, a researcher washes the biomass with water and adds the enzyme, all within the same microwell. No need for weighing biomass or metering slurry.

This method is also an ideal way to prepare a pure sample of biomass for imaging. “The imaging people see this as an imaging platform,” Rajiv says. “That wasn’t our original intent, but it’s another application of this method.”

Speed and efficiency also are the focus of the third

## **Sandia** CaliforniaNews

JBEI paper. “A microscale platform for integrated cell-free expression and activity screening of cellulases” appears in the November issue of the *Journal of Proteome Research*. Aarthi is the lead author with contributions from Rajiv, Joshua Park (8634), Rajat, Paul, and Anup.

This work addresses the problem of screening hundreds of thousands of variants of cellulases, which is currently done by expressing into *E. coli* or yeast, a process that can take weeks.

“The question is, ‘can we bypass the entire process by doing the first level of screening in something that is higher throughput, much faster, and simpler?’ And expressing cell-free, with no need for living *E. coli*?” Aarthi asks.

The research team developed a first-pass screening device for quantitative large-scale screening of cellulase variants. They adapted commercial off-the-shelf cell-free expression kits to express a large number of cellulases. Using a microfluidics platform, the scientists integrated an assay for evaluation and connected it to a fluorescent readout, enabling what Aarthi terms “a one-stop shop.”

“It’s a quick, simple solution to a very costly problem,” she says. “The microfluidics platform achieves the entire process of transcription, translation, and activity screening within two or three hours, compared with the days necessary for conventional cell-based cellulase expression, purification, and activity screening.”

By performing expression and screening within the same reaction volume, researchers can express many variants of cellulases and know almost immediately if they are active or not. Scaling down the dimension and volume to a microfluidics platform accelerates the process and reduces the amount of reagent needed, a tremendous cost savings.

“The methods described in these papers will enable scientists at JBEI and beyond to push the boundaries of bioenergy research,” Anup says. “The faster we can screen and evaluate components of the biomass to biofuel process, the closer we get to moving biofuels from a concept to a reality.”

JBEI is now one of three new DOE Bioenergy Research Centers. This San Francisco Bay Area scientific partnership is led by Lawrence Berkeley National Laboratory and includes Sandia, the University of California (UC) campuses at Berkeley and Davis, the Carnegie Institution for Science, and Lawrence Livermore National Laboratory.



# Z machine

(Continued from page 1)

proof of fusion. But a major reason not enough neutrons have been produced to provide a source of peacetime electrical power is the MRT instability.

Dan led seven experimental shots to map the disturbance. The experiments were motivated by a concept proposed last year by Steve Slutz (1644). Traditionally, scientists would use an array of spidery wires to create a compressed, X-ray-generating ion cloud. The X-rays were then used to compress fusion fuel. Steve suggested instead that the magnetic pinching forces could be used to directly fuse fuel by compressing a solid aluminum liner around fusion material preheated by a laser.

Because the new concept would not produce X-rays as a heating tool but instead relied on directly compressing the fuel with magnetic pressure, the MRT instability was the primary threat to the concept.

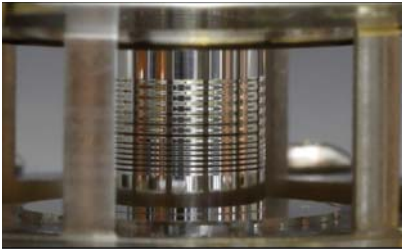
“Once we started looking at solid liners, it was easy to conceive of doing a controlled experiment to study the growth of the instability,” says Dan.

This is because experimenters could etch solid tubes to whatever degree they desired to provoke the instability. Accurate etching is not an option with fragile wire arrays.

The MRT problem occurs because even minute dips in a current-carrying surface — imperfections merely 10 nanometers in amplitude — can grow exponentially in amplitude to millimeter scales. In the experiments by Dan and others, the tubes were scored with a sinusoidal perturbation to intentionally start this process.

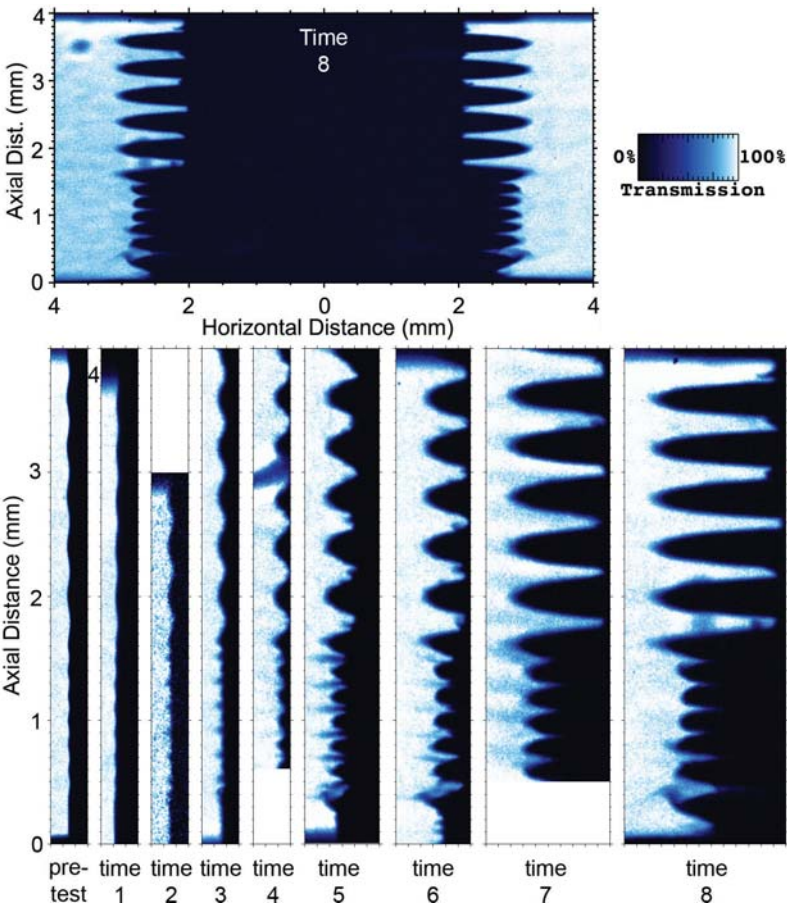
“The series of pictures over a time scale of 100 nanoseconds brought the life of the MRT into focus,” says Dan.

Previously, competing computer simulation programs had given conflicting predictions as to the extent of the threat posed by the MRT instability, leaving researchers in the position, says Dan, of “a man with two watches: he never really knows what time it is.”



THIS IS AN OPTICAL photograph of an aluminum z-pinch target tube installed in the Z machine.

THE IMAGE AT TOP RIGHT is an X-ray (6.151 keV) photograph of the same target (see photo above) compressed by electromagnetic forces. The sequence of images below is cropped to show both outside edges of a cylinder from a camera's point of view as they distort over time in the grip of the MRT instability. Some of the jet-like features are approximately 50 microns, smaller in diameter than a human hair.



The more accurate simulations will enable researchers to better tweak the conditions of future Z firings, more effectively combating the effect of the instability.

Researchers believe that with thick liners and control of the MRT, Z could achieve an output of 100 kilojoules to match the 100 kilojoules input to the fuel to start the fusion reaction. “That would be scientific breakeven,” says Dan. “No one has achieved that.”

But that day, he says, may be just two to three years away.

The work is reported in a paper in the Oct. 29 issue of *Physical Review Letters* and was the subject of Dan’s invited talk on Nov. 17 at the APS Plasma Physics meeting in Chicago. The work was paid for by Sandia’s Laboratory Directed Research and Development program and DOE.

# Survey

(Continued from page 1)

Americans would prefer to see an energy mix comprising 50 percent renewable energy sources (currently 6 percent), 28 percent fossil fuels (currently 85 percent), and 22 percent nuclear generation (currently 8 percent).

The findings come from the 2010 National Security Public Attitudes Project, conducted by principal investigators Hank Jenkins-Smith, Kerry Herron, and Carol Silva of the Center for Applied Social Research (CASR) at the University of Oklahoma. Conducted since 1993, this unique annual study assesses Americans’ attitudes toward a broad range of national security issues. Sandia cofunds the study with the University of Oklahoma and uses the results to help inform its mission areas.

Results of the latest survey were presented at Sandia in late October.

“Although we, as Sandians, are immersed in elements of national security in real and tangible ways, it is important to keep in mind that the public’s attitudes and understanding of issues play an essential role in setting national policy,” says Lori Parrott, manager of Strategic Studies Dept. 552. “For example, the public plays a key role in shaping national security priorities and outcomes. Understanding the public’s perceptions of their safety and security, as they relate to dimensions of national security, assists us in understanding how best to inform national debate.”

The National Security Public Attitudes Project is a unique study in two significant ways. No other study has been conducted over as long a period of time, and no other study covers as broad a scope of national security topics.

“While similar studies focus on public attitudes toward specific topics, the National Security Public Attitudes Project assesses attitudes toward many dimensions of energy security, nuclear security, and the threat of terrorism,” Lori says. “Its scope allows us to generate a much more complete view of how the public perceives national security.”

With regard to energy security, the study’s 2010 results revealed that respondents’ confidence in the nation’s energy future is on an upward trend, increasing from 5.01 in 2008 to 5.63 (on a Likert-type scale, with 1 meaning “not confident at all” and 10 meaning “completely confident”). Further, respondents reported that the most important prospective energy technology R&D would be in areas of solar, wind, and hydro energy, while they ranked clean coal, nuclear energy, and oil and gas as least important for investment.

Shifting to the second portion of the study, public attitudes on nuclear security mirror the complexity of the issue. While many respondents consider nuclear abolition to be desirable, 80 percent do not think it is feasible.

According to the study’s results, 73 percent of respondents believe that “the US nuclear arsenal deters attacks and ensures our security, and that these benefits far outweigh any risks from US nuclear weapons.” Further, a large majority does not want the US to have fewer nuclear weapons than any other country and eight out of 10 people reject unilateral US nuclear disarmament.

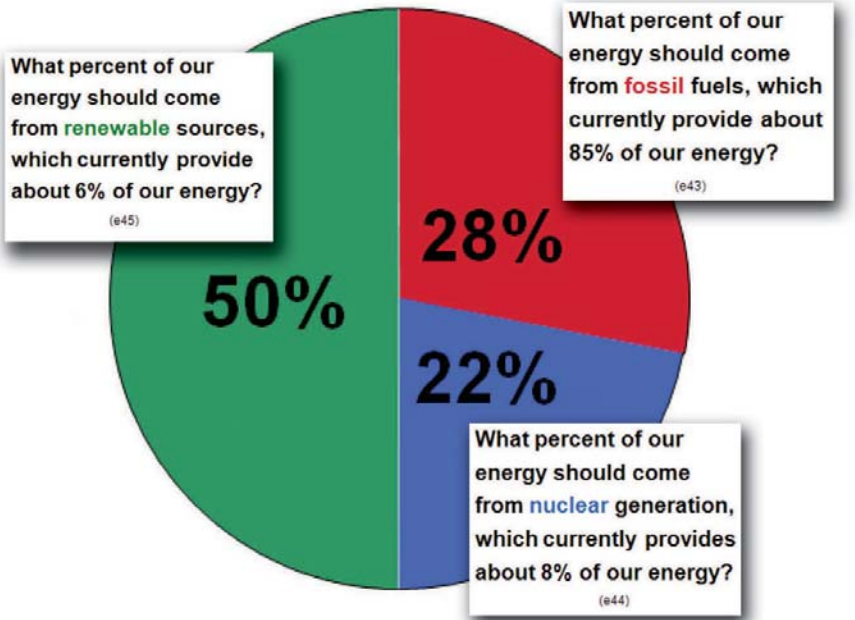
Respondents said they believe nuclear weapons are relevant for deterring other countries from using nuclear weapons against the US, deterring other countries from providing nuclear weapons or material to terrorist groups, and for helping maintain US international influence, status, and military superiority. However, a nearly even split emerged concerning the effectiveness of the US nuclear arsenal in deterring the use of weapons of mass destruction by terrorists and nonstate actors, with 51 percent perceiving great utility and 49 percent perceiving little utility).

In addition to issues related to nuclear weapons and energy policy, the 2010 National Security Public Attitudes Project also questioned respondents about the threat of terrorism. Although predictably peaking right after the Sept. 11 attacks, respondents’ average assessment of the overall threat of terrorism in the US has declined approximately 16 percent over the years, though currently remaining well above pre-Sept. 11 assessments (7.55 on a Likert-type scale with 0 meaning “no threat” and 10 meaning “extreme threat”).

Respondents indicated midscale confidence in the US government to prevent terrorist attacks in the US, with a score of 5.01 on a Likert-type scale, with 1

# Future Energy Mix Mean Preferences In Next 20 Years

Combined Data: 2006–2010



IF THE PUBLIC’S REPORTED PREFERENCES become reality, the nation’s energy landscape will look very different from the one that exists today.

meaning “not confident at all” and 10 meaning “completely confident”), as well as midscale confidence in the nation’s ability to accurately assess threats of terrorism both at home and abroad (4.77 in US and 4.46 abroad).

The 2010 survey also probed respondents’ opinions about measures designed to mitigate the threat of terrorism. The top measures for which respondents reported tolerance were restricting immigration (70 percent), requiring national identification cards (60 percent), and monitoring telephone calls (49 percent). The areas of least reported tolerance were monitoring behaviors (54 percent), taking unauthorized photos (55 percent), and sampling DNA (50 percent). Tolerance for trading personal liberties for increased levels of security increases with age, political conservatism, and perceptions of the terror threat.

The 2010 National Security Public Attitudes Project will soon be available as a SAND report.





# Former Santa Fe Institute president to speak to first gathering of Catalyst Networking Group

By Heather Clark

The founder of the high-energy physics group at Los Alamos National Laboratory and former president of the Santa Fe Institute will speak at Sandia's first Catalyst Networking Group gathering about universal scaling laws, how they pervade biology and the social sciences, and what questions that raises about sustainability.



GEOFFREY WEST

Geoffrey West is a theoretical physicist who has worked on fundamental questions such as quarks, gluons, string theory, and dark matter, but more recently has worked extensively in biology. He will address the group, which is scheduled to meet from 5-7 p.m., Nov. 30, at the National Museum of Nuclear Science & History.

"It's a grand overview of many things that in the end lead to a host of fundamental questions about sustainability in the general sense," West says of the upcoming talk. "Can we sustain the life, the standard of living we have, and the kinds of ways in which we continually innovate and continue to increase the pace of life that accompanies all of this?"

West's talk will be the first of the presentations that will occur quarterly to provide a forum for cross-disciplinary interactions among Sandians who are interested in or curious about entrepreneurship or commercializing their technology, says Natalie Carter (1931), who is organizing the presentations.

Future speakers will include leading thinkers from diverse disciplines whose common theme will be innovation and commercialization, she says.

In addition to being a networking opportunity for potential entrepreneurs, Natalie says she hopes participants will be able to take a step back to look at the big picture when it comes to issues facing society.

West, who was president of the Santa Fe Institute from 2005-2009, is pondering the big questions. He asks whether the human race will revert to being hunter-gatherers or progress to a glorious future? And, he wonders whether humans can have more and more innovation without socioeconomic growth?

West will talk about his work applying scaling laws to fundamental biological phenomena — What's the difference in metabolism between an elephant and a

mouse? How does the length of the aorta compare in different organisms? How long does it take various organisms to mature? — and using the laws he's discovered as a window to reveal the fundamental dynamics controlling biological organisms and processes.

Now, West says, he's applying scaling laws and his theory to other systems, such as cities, companies, and other networks to look at the relationship between economies of scale, growth, innovation, and wealth creation.

While still a work in progress, West says his theory predicts that if cities are driven by wealth creation and innovation, the pace of life must systematically increase with size.

"The image I have is that we are running on an accelerating treadmill, and it's hard not to speculate from this that it is impossible," West says.

Ultimately, the pace of human innovation will increase so that we'll have to come up with a major innovation every three months, he says.

West doesn't have all the answers. He says his grand vision is to develop a quantitative predictive, theoretical, and conceptual framework so society can better understand these issues.

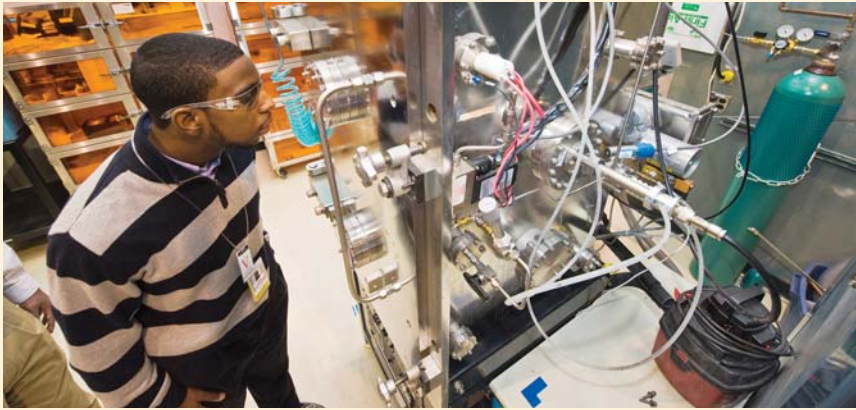
"We've taken ourselves to a precipice. Is there so much momentum in what's happened that we're going to be a bunch of lemmings and go over the edge or will we understand that there's a cliff there and avoid the edge?" he asks.

West says it's hard to tell whether his talk will spark innovation in his listeners that organizers of the event are hoping for, but his ideas have led to a lot of discussion among other audiences who have heard him, from the World Economic Forum in Davos, Switzerland, to corporate leaders from Silicon Valley, and from the manufacturing sector to the investment community. His work was named as a breakthrough idea of 2006 by *Harvard Business Review*.

The Catalyst Networking Group, which is co-sponsored by Technology Ventures Corp., is one of several mechanisms designed to strengthen the culture of innovation at Sandia. Other programs include the Entrepreneurial Separation to Transfer Technology, the annual Entrepreneurial Spirit Awards Luncheon, the Center for Commercialization & Entrepreneurial Training and the annual Innovation & Intellectual Property Celebration.

For more information or to register, contact Natalie at 844-0165 or [nacarte@sandia.gov](mailto:nacarte@sandia.gov).

## Labs hosts Howard University students



HOWARD UNIVERSITY STUDENT Todd Hughes views the plasma glow around the source material as he looks into a sputter chamber at the Materials Processing & Coatings Laboratory (MPLC).

Photos by Randy Montoya

A group of Howard University students visited Sandia earlier this month to report on their interim findings on a project they are working on under the sponsorship of Sandia's Engineering Sciences Center (1500). The center sponsors two year long senior capstone projects in the Mechanical Engineering Department at Howard University in Washington, D.C. This year's project, "Particle Interactions under Controlled Flow Conditions," involves operation of two flow cells: a controlled shear cell and a sedimentation cell. Students design, build, test, analyze, and report on results twice during the academic year. Tim O'Hern (1512) leads the project and is an adjunct professor at Howard. The students visited several Labs facilities and heard presentations on a number of ongoing Sandia projects. Students met with members of the Black Leadership Committee for dinner one evening and discussed career and internship opportunities.



PROFESSOR HORACE WHITWORTH, left, professor Grant Warner, Michael Gallion, Shem Franklin, Todd Hughes, Ricardo Charles, and Jennifer Kelso examine a beaker showing the electroplating of copper, nickel, and gold in the electrochemical lab at the MPLC.

## Karen McDaniel receives AISES award for technical excellence

By Iris Aboytes

Karen McDaniel (2991) received an AISES award for technical excellence at ceremonies during the 2010 AISES National Conference at the Albuquerque Convention Center Nov. 11-13.

The American Indian Science and Engineering Society (AISES), established in 1977, works to increase American Indian/Alaska Native representation in science, technology, engineering, and math, as students, professionals, mentors, and leaders.

Karen works with structural and thermal computer simulation in support of the nuclear weapons (NW) stockpile, NW life extension programs, and satellite programs. She develops multidimensional finite-element models for structural and thermal analysis.

Karen grew up on the Navajo reservation in Upper Fruitland, N.M. She helped with farming and tending the sheep. Her mother, Lorraine, was a stay-at-home mom. Her father, Tom Max Sr., worked as a coal miner. "We planted corn and vegetables in the spring, and we weeded and irrigated the fields all summer," she says. "To this day our whole family, my two brothers and sister and I, all go home to help with the harvest.

"We would all shear the sheep. I would help my grandmother, Alice Max, prepare the wool and dye it. Once it was cleaned and dyed, I would help her brush the wool and then spin the wool into yarn."

Karen saw her father work long shifts at the mine and come home almost to the point of exhaustion every day. She saw the type of work that can be done without a college education, and although it was stable, it was very difficult.

The majority of students in her high school were Navajo. Karen does not remember any American Indian professionals visiting the schools and talking to them about career possibilities.

Karen began attending San Juan College in Farmington, enrolling in classes she liked, but she was always doing something with computers. She took calculus and other higher-level math classes. "They contained the types of problems and critical thinking I enjoyed," Karen says.

She moved to Albuquerque and earned a bachelor's in mechanical engineering at the University of New Mexico. She was determined to earn her undergraduate degree, and it wasn't until she met Sandra Begay-Campbell at an event sponsored by the Native American Programs School of Engineering that she decided to follow in the same footsteps. She continued and earned her master's degree.

Karen is a former chairperson of the American Indian Outreach Committee (AIOC) and is part of Sandia's AISES recruiting team. The AIOC offers the annual Dream Catcher program for middle school American Indian students.

"I know firsthand that the local community appreciates the classes," Karen says.

Karen is married to Jeff McDaniel. They are the proud parents of two sons, Shawn Max, 13, and Jayden McDaniel, 5. Karen is very proud of her family, heritage, culture, and home that she and her husband have built together. She credits her parents with instilling in her motivation, drive, and strength.

"They are my inspiration," Karen says. "My family means everything to me."



KAREN MCDANIEL



# Mileposts

New Mexico photos by Michelle Fleming  
California photos by Randy Wong



Brian Chamberlain  
35 8944



Bert Tate  
35 5336



Al Ver Berkmoes  
35 8238



Janet Ahrens  
30 6814



Ken Condreva  
30 8135



Kathleen Diegert  
30 2950



Christine Garcia  
30 5097



Brenda Langkopf  
30 6234



Anthony Thornton  
30 5220



Eleanor Walther  
30 5928



Rodney Wilson  
30 6800



Edward Young  
30 5936



Eunice Young  
30 5528



Shawn Kerr  
25 2662



Alice Kilgo  
25 1822



Jim Lauffer  
25 8231



Lydia Perez-Romo  
25 4234



Grace Thompson  
25 6831



Becky Wilcox  
25 10656



Patricia Zamora  
25 3652



Karen Armstrong  
20 4135



Michelle Barela  
20 10541



Earl Conway  
20 5762



Pam Tyler  
20 10501



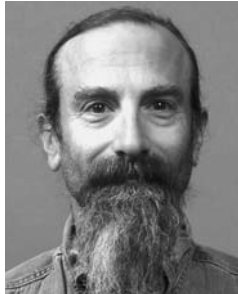
Judy Cardenas  
15 4225



Julie Ludwig  
15 10657



Sheila Pounds  
15 10657



Thomas Russo  
15 1437



Scott Sanderville  
15 6621



Dawn Skala  
15 8238



Todd West  
15 8114



50 years ago . . . A new facility at Sandia, the Physical Electronics Laboratory, will make it possible for Sandia research and development organizations to undertake advanced concepts in and fabrication of vacuum electronic devices. Final stages of work and testing of vacuum electronic devices are carried out in a specially constructed stainless steel and glass “clean room.” Absolute cleanliness is used to guarantee the high quality of vacuum devices. Steps undertaken to achieve a clean working device include chemical cleaning, ultrasonic vapor degreasing, and rinsing in deionized water.

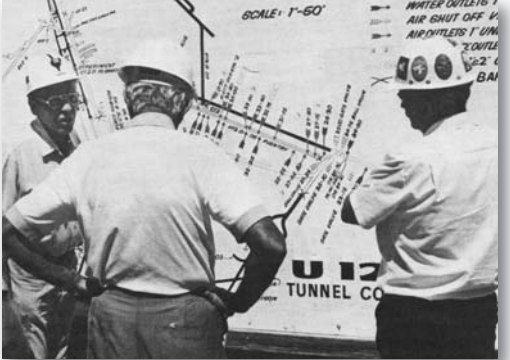


INSIDE THE CLEAN ROOM — Vernon Smith (4233) prepares a tube for induction brazing in a vacuum bell jar as T. J. Williams (1431) watches the operation.

40 years ago . . . The first of its type in the country, the new Sandia rocket sled launching facility consists of a 300-foot section of rails mounted on a ramp at the south end of the 5000-foot sled track. By changing the five



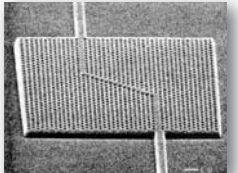
TWO DEGREE UPWARD LAUNCH RAMP used in testing on Sandia's rocket sled track. structural steel support sections, the rails can be sloped up or down. The downward curve will be used for impacting test units into concrete or other targets. Upward slopes will be used for launching test units into free flight for test of parachutes and similar hardware.



30 years ago . . . At the Nevada Test site, the nuclear experiment, Miners Iron, had a successful detonation. Prior to the test, President Sparks visited NTS and is shown (back to camera) with Howard Viney (1130) outside “G” tunnel where the closure protection system for the experiment was tested. Glen Fowler (VP-1000) stands at right.

20 years ago . . . A team of Sandians and University of Wisconsin researchers has developed and used high-temperature superconducting transistors in a variety of working electronic circuits. This high-speed transistor, called the Superconducting Flux Flow Transistor (SFFT), is an “active” device, meaning it has electronic switching properties. These properties are useful in electronic communications, microwave circuitry, and digital logic applications. Superconductors are materials that allow electrical current to flow through them without resistance or energy loss.

10 years ago . . . A tiny bar that in appearance resembles cheesecloth has bent infrared beams with very little loss of light in laboratory experiments at Sandia. The bar is fabricated from gallium opens the possibility that sive, essentially two-dimensional can drastically reduce the start and operate a laser. small light loss, the technique of ultimately replacing with faster, cooler photonic technique could be used to control electrons in a single chip to relay as well as changing cal signals coming through telecommunications lines.



AROUND THE BEND — The perforated two-dimensional gallium arsenide shape.



# Sandia celebrates Veterans Day and Native American Month in grand tradition

**In New Mexico**  
*photos by Randy Montoya*

The air was crisp, but the bright blue sky with its radiant sun kept everyone warm as they gathered at Hardin Field to honor Native American heritage and veterans, the Guard, Reserve, and military personnel. It was a celebration in the Sandia tradition.

A variety of military vehicles, including a Blackhawk helicopter and several specialty devices, were on site. Members of the military stood ready to talk to visitors about the exquisite equipment.

Each intricate aspect of the program honored culture, heritage, and service. A color guard brought the true reality of the event. The national anthem was sung by Katherine Arviso in Navajo. The Sandia Singers followed with a song of their own.

The special program, done in partnership with Kirtland Air Force Base and the Employer Support for the Guard and Reserve (ESGR), included special guests: KAFB Commander Col. Robert Maness, New Mexico Department of Veterans' Services representative Thomas Wagner, Navajo Code Talkers Roy Hawthorne and Peter MacDonald, and members of Sandia's executive management, including Labs Director Paul Hommert.

The tempting smells came from fry bread prepared by Sandia's American Indian Outreach Committee (AIOC). About 800 Indian tacos were prepared. Volunteers from Sandia's various outreach committees kept the line moving with their swift service. The fry bread was warm and tasty. Some enjoyed the fry bread by itself or with honey, while most chose to enjoy it as Indian tacos.

The audience was provided an insight into native culture and traditions as the Zotigh Drum Group played while the Church Family Dancers demonstrated various traditional dance styles. In the final dance everyone was invited. Event dignitaries and executives joined with the two Code Talkers, the Church Family Dancers, and audience members in a memorable experience. Ron Hoskie's (4842) flute provided a perfect closing to the event.

The celebration was coordinated by a committee led by Machel Karler (3512) and Marie Brown (40) and members of Sandia's AIOC in collaboration with representatives of Kirtland Air Force Base.



KATHERINE ARVISO sings the national anthem in Navajo.



CEREMONIES BEGIN as a Kirtland Air Force Base diversity color guard presents the flags.



NAVAJO CODE TALKERS Peter MacDonald and Roy Hawthorne listen to the Veterans Day speakers.



CHURCH FAMILY DANCERS prepare to demonstrate their traditional dances.



DOUG BROWN and Jose Alves (both 8511) raising the flag.

## In California

*photos by Dino Vournas*

On Nov. 11, the new Sandia/California Veterans Outreach Committee hosted the site's first-ever Veterans Day Flag Raising Ceremony, led by the Monterey Presidio, Joint Color Guard Defense Language Institute Foreign Language Center (DLIFLC), and US Security Associates, Inc. Protective Force. Soloist Elaine Johnson from Lawrence Livermore National Laboratory sang the national anthem.

"Today it's common to think of a veteran as someone who at one point in their life wrote a blank check to the US government for the amount up to and including their life," said Jim Berry (8949), chair of the Veterans Outreach Committee and an Army veteran. "If you have served in the military, you have signed that blank check. We want to thank you for your commitment, your sacrifice, and your willingness to serve others even if it could cost you your life or serious injury."



SOLOIST ELAINE JOHNSON from Lawrence Livermore National Laboratory sings the national anthem.



JIM BERRY (8949), chair of the Veterans Outreach Committee, making his remarks during the event.



LEN NAPOLITANO (8900), director champion of the Veterans Outreach Committee, addresses the attendees.